NOvA
Accelerator and NuMI Upgrades

Shutdown 2009

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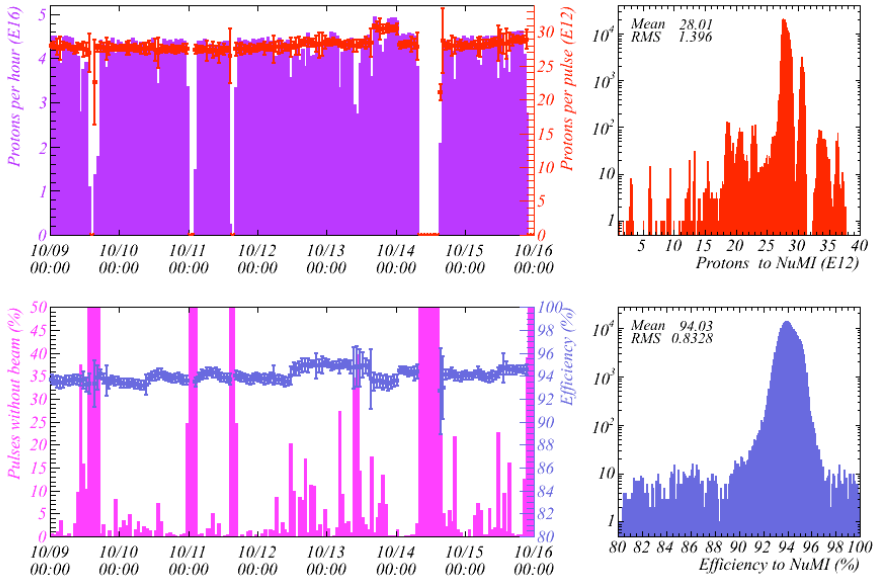
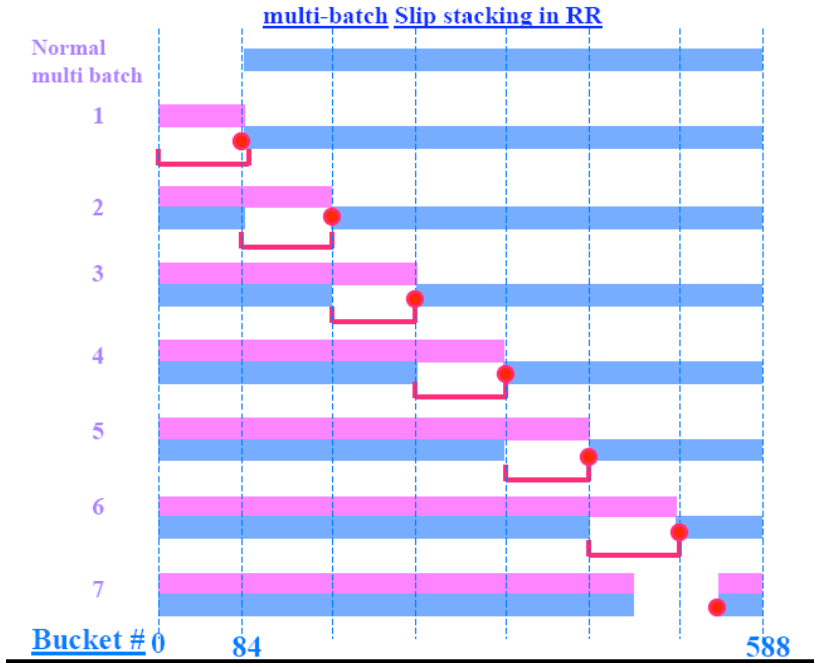
Accelerator and NuMI Upgrades for NOvA

- Current Operation: 2.2 sec MI cycle
  - Slip stacking in the Main Injector
    - 2 booster batches to pbar (~7e12)
    - 9 booster batches to NuMI (~28e12)
  - 11/15 (0.733) sec to accumulate protons
  - 1.47 sec Ramp (204 GeV/s)
  - 1e13/2.2 sec at 120 GeV corresponds to 87 kW
    - 9 to NuMI: 240 kW
    - 11 to NuMI: 300 kW



NOvA/ANU

- Operation for NOvA: 1.33 second MI cycle
  - Slip Stacking in the Recycler
    - 12 booster batches for NOvA
  - Single turn fill in MI (11 μsec)
  - 1.33 sec ramp (240 GeV/s)
  - 1e13/1.33 sec at 120 GeV corresponds to 144 kW
    - 4.9e13 -> 700 kW



- ALARA: minimize losses

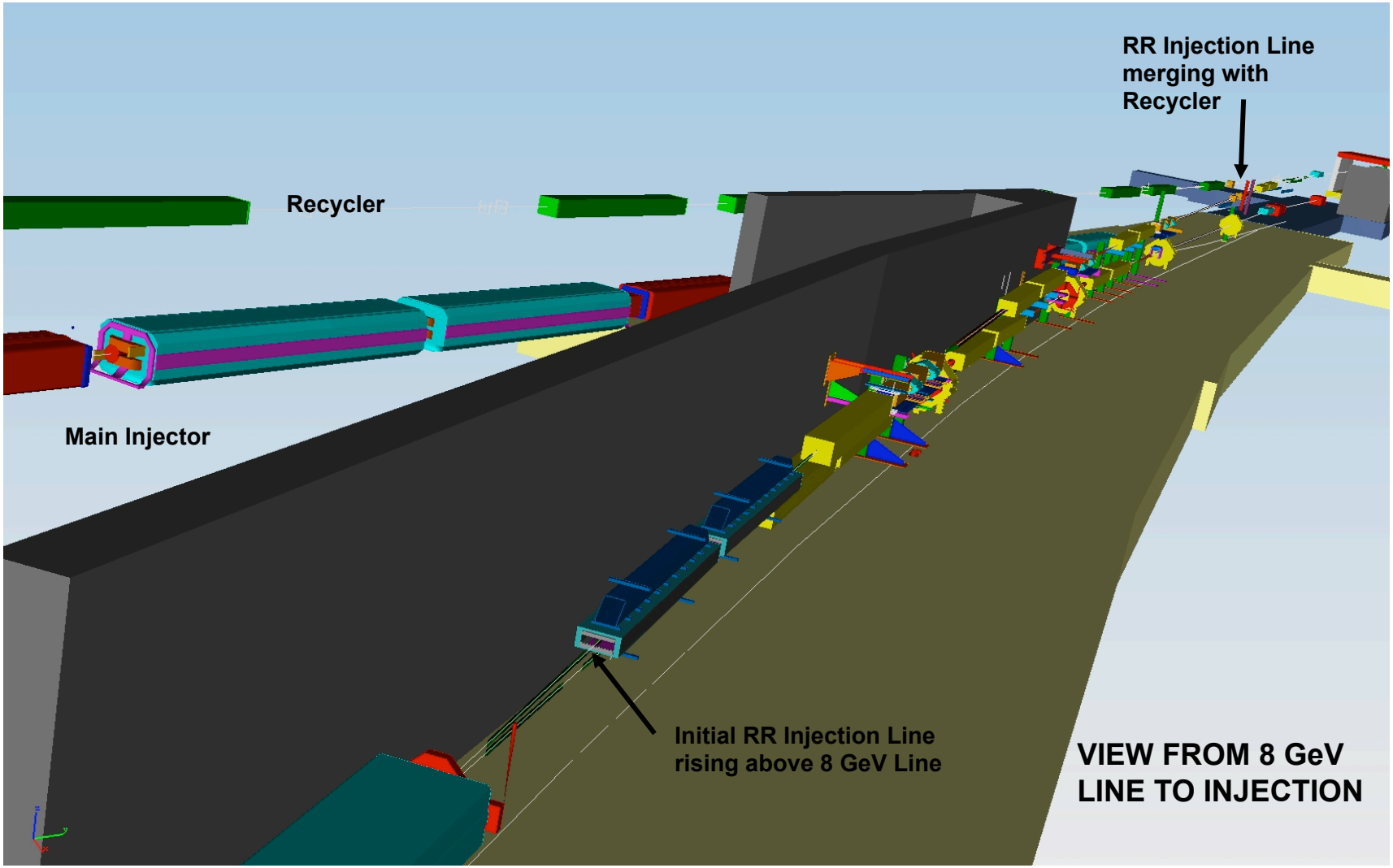
Context of ANU

- Changes to the FNAL Accelerator complex to
  - Turn Recycler from pbar to proton ring
    - Injection and extraction lines
    - Associated kickers and instrumentation
    - 53 MHz RF
  - Shorten MI cycle to 1.33 seconds
    - RF upgrades
    - Power Supply upgrades
  - NuMI target station to 700 kW
    - Target
    - Horns
- On project and off project work that supports NOvA

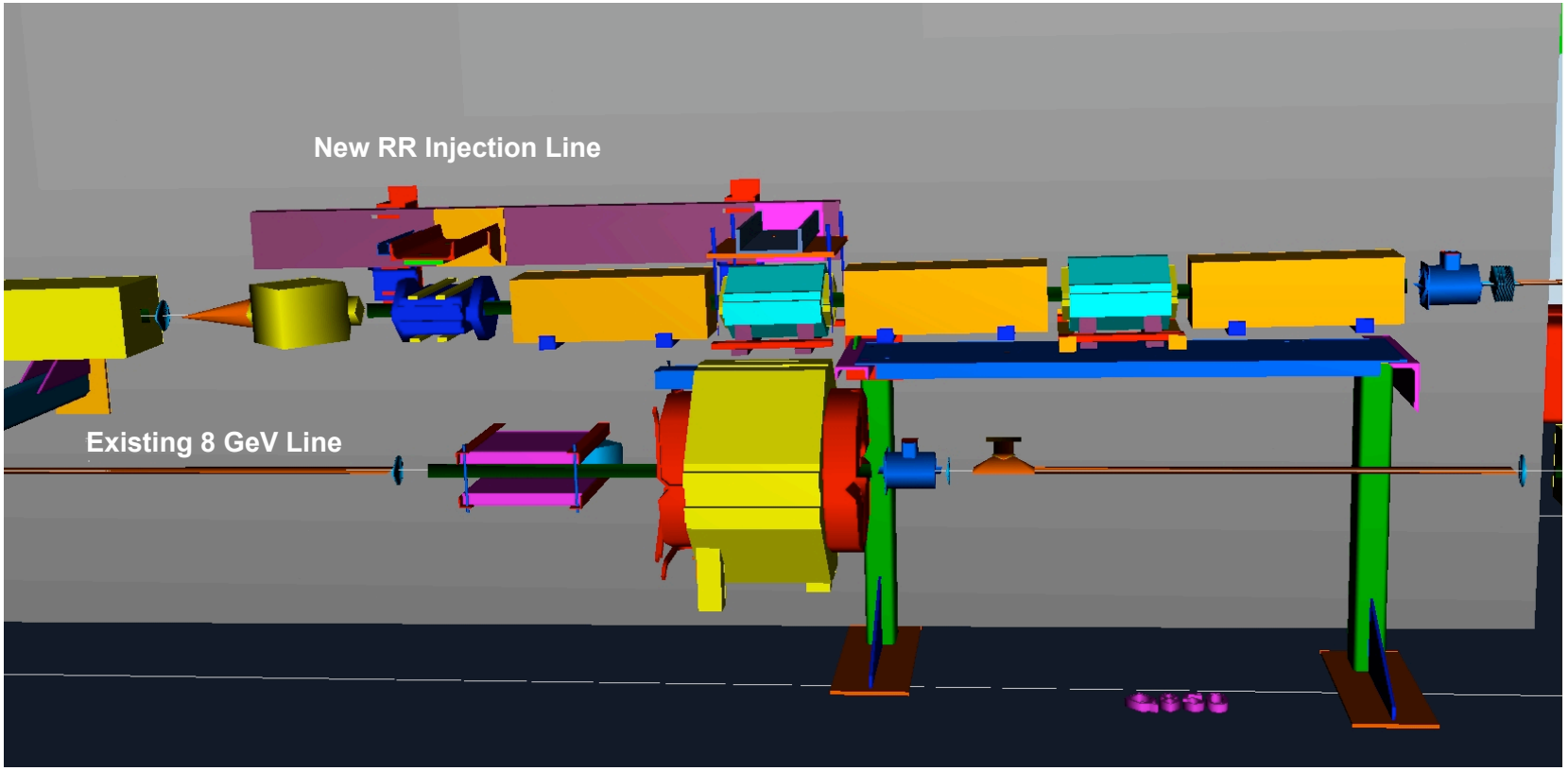
Shutdown 2009

- Beamline Planning
  - Layout/inspection/interferences/stand design
- Civil construction work: MiNU (GPP, not in NOvA project)
  - 2 new service buildings: Need space
    - MI 14: Injection line into Recycler
    - MI 39: Beam abort kickers
  - New Anode Power supply room: more RF power
    - Faster ramp: 20 MI cavities vs 18, new Recycler 53 MHz RF
  - Floodplain Mitigation: new buildings
- Installation of Gap Clearing Kickers in MI (AIP, not in NOvA project)
  - 7 kicker magnets in MI-40 beam abort area
  - Clear injection gap of beam before next injection

Work in Progress – RR Injection Line Modeling



Work in Progress – RR Injection Line Modeling

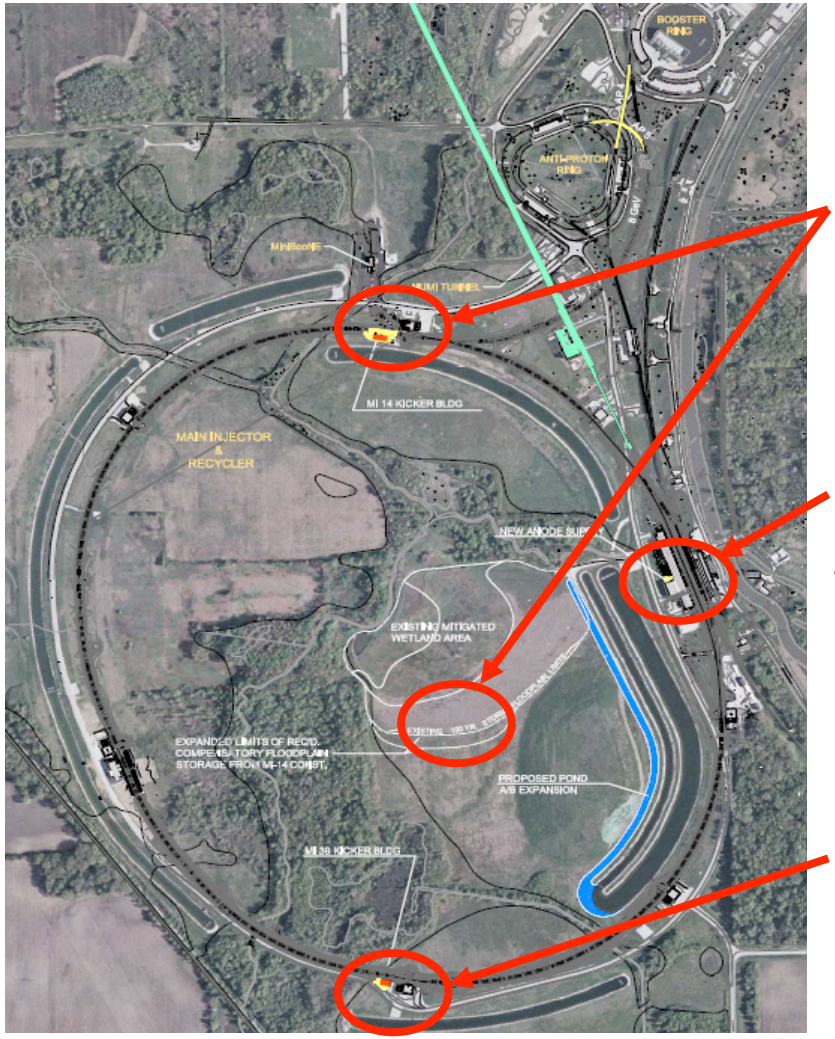


8 GeV LINE AT 850

Off project work – MINU

- Main Injector Neutrino Upgrades GPP
  - New MI-14 & MI-39 Service Buildings
  - MI-60 Anode Supply Room addition
- For power supplies, controls, etc for new kicker systems and beamlines
- Construction during 2009 shutdown
  - Penetration conduits to MI tunnel
  - Building foundations
  - All utilities that impact the MI berm
- Buildings on surface to be complete December 2009

MINU Project Locations

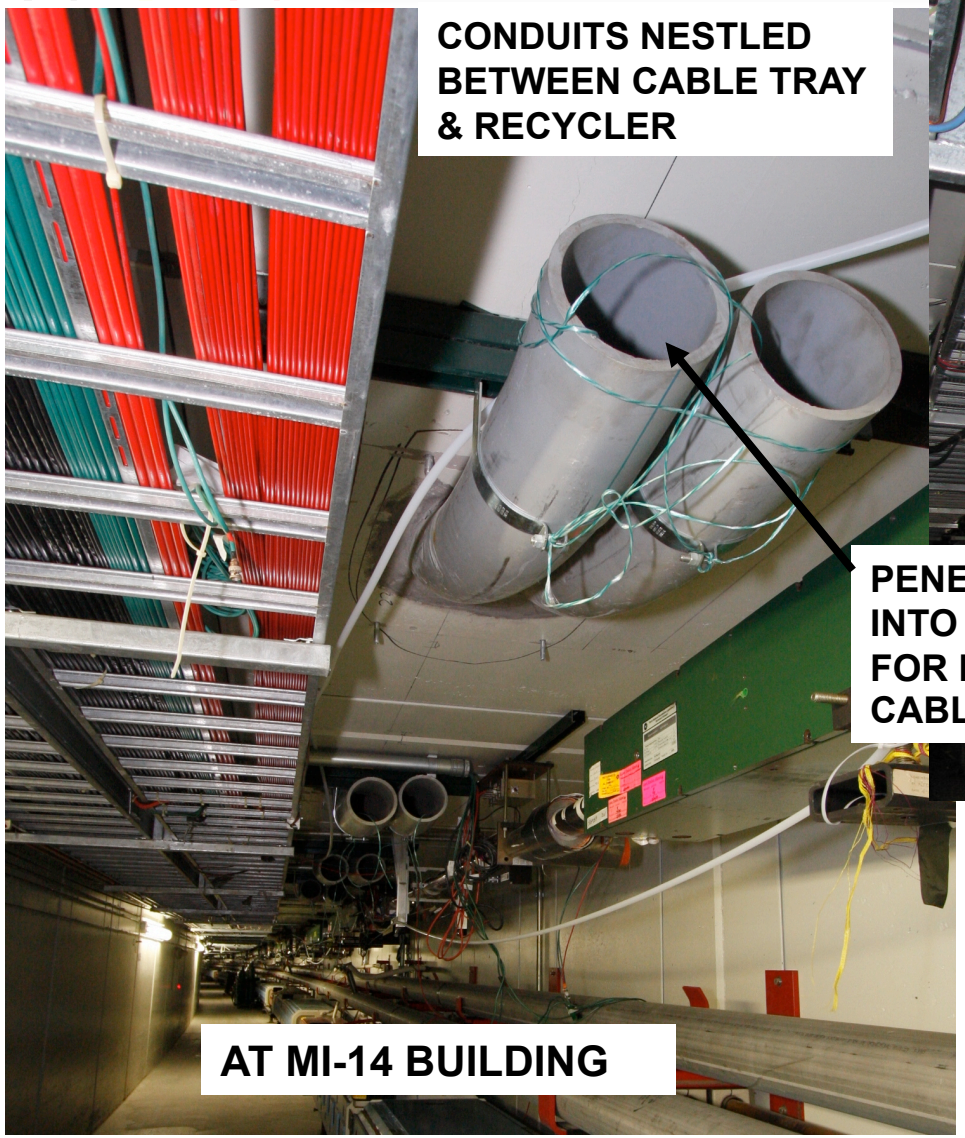


MI-14 Service Building
(2250sf; also floodplain mitigation)

MI-60 4th Anode
Supply Room
(250sf)

MI-39 Service Building
(1500sf)

Penetrations in Tunnel



MI 14 Conduits

MI-14 Building – at end of shutdown

FOUNDATION WORK COMPLETE

MI-14 Building – Oct 15th

AWAITING SIDING, ELECTRICAL AND PAINTING IN PROGRESS

MI 39 Berm and Penetrations

MI-39 Building – at end of shutdown

FOUNDATION WORK COMPLETE

MI-39 Building – Oct 15th

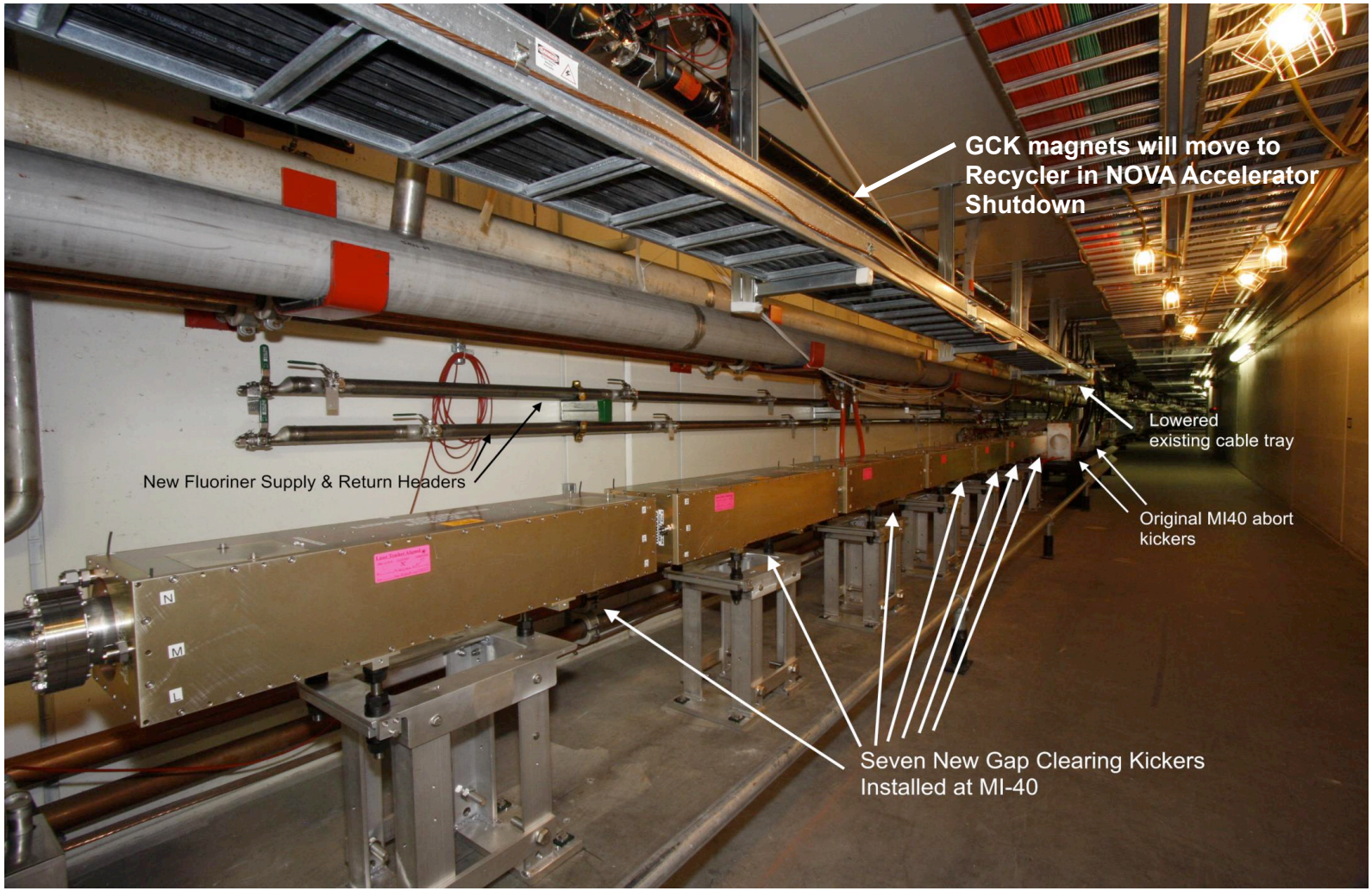
SIDING, ELECTRICAL, FIRE PROTECTION, HVAC IN PROGRESS

MI-60 Anode Supply Room

NEED ROOFING AND SIDING TO BE COMPLETED

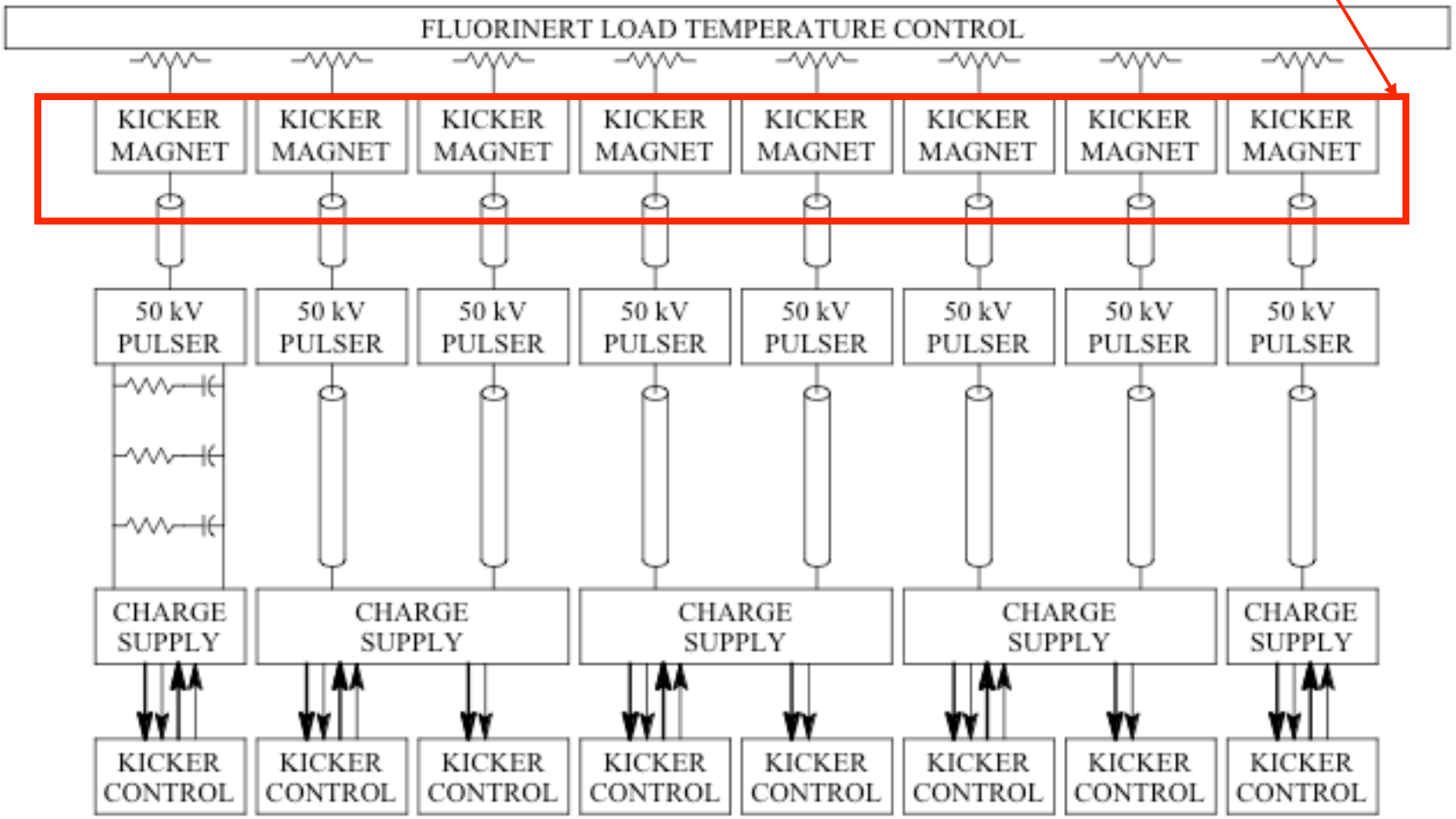
Off project work – Gap Clearing Kickers

- 7 magnets installed during 2009 shutdown: ALARA



Gap Clearing Kicker System

INSTALLED DURING SHUTDOWN



REMAINING COMPONENTS TO BE INSTALLED IN NEW BUILDINGS EARLY 2010, THEN IN TUNNEL IN SHORTER SHUTDOWNS

Off project work – Gap Clearing Kickers

- Gap Clearing Kickers remaining work installation plan:
  - After MI-39 Building is able to be occupied
    - install communications connections
    - Install racks, power supplies, cooling skids
  - During 2010 summer shutdown
    - Pull cables from building to tunnel
    - Install LCW piping
    - Make system operational
  - During NOvA Accelerator shutdown in 2011-12
    - Move these kickers to Recycler

NOvA/ANU Shutdown work

- Installation planning work for beamlines
  - Interferences and 3d models based on tunnel inspections and drawings

- MINU GPP:
  - 2 new service buildings (MI 14 and MI 39)
  - New anode power supply room
  - Floodplain mitigation

- Gap Clearing Kicker AIP:
  - 7 magnets in tunnel
  - When service buildings complete, installation in buildings
- Summer 2010
  - Cable pulls and final connections of GCK